SPACELAB EXPERIMENT : ALAE

ATMOSPHERIC LYMAN-ALPHA EMISSIONS

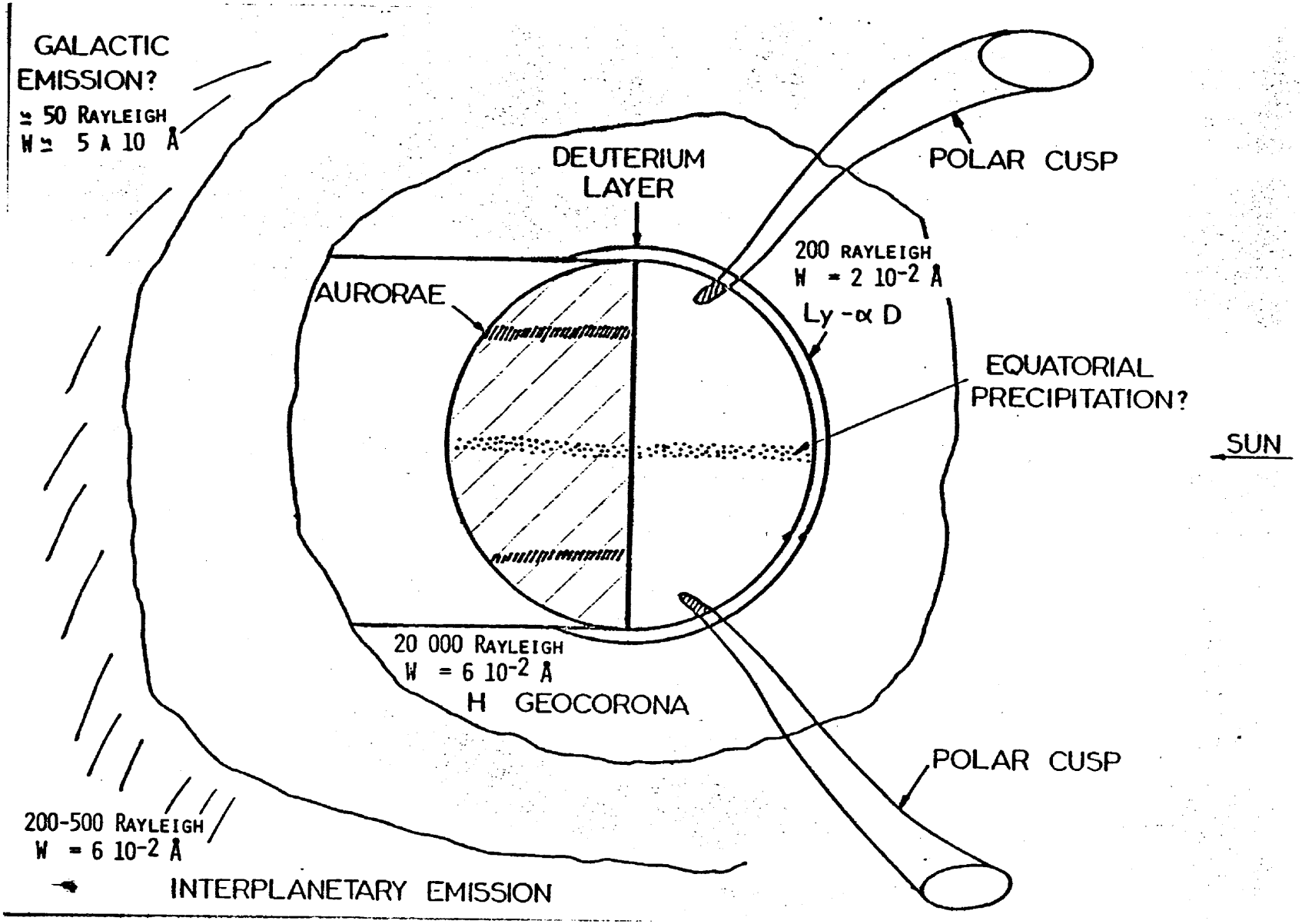
J.L. BERTAUX (PI,SA) ; FLORENCE GOUTAIL (CO-I,SA)
G. KOCKARTS (CO-I,IASB)

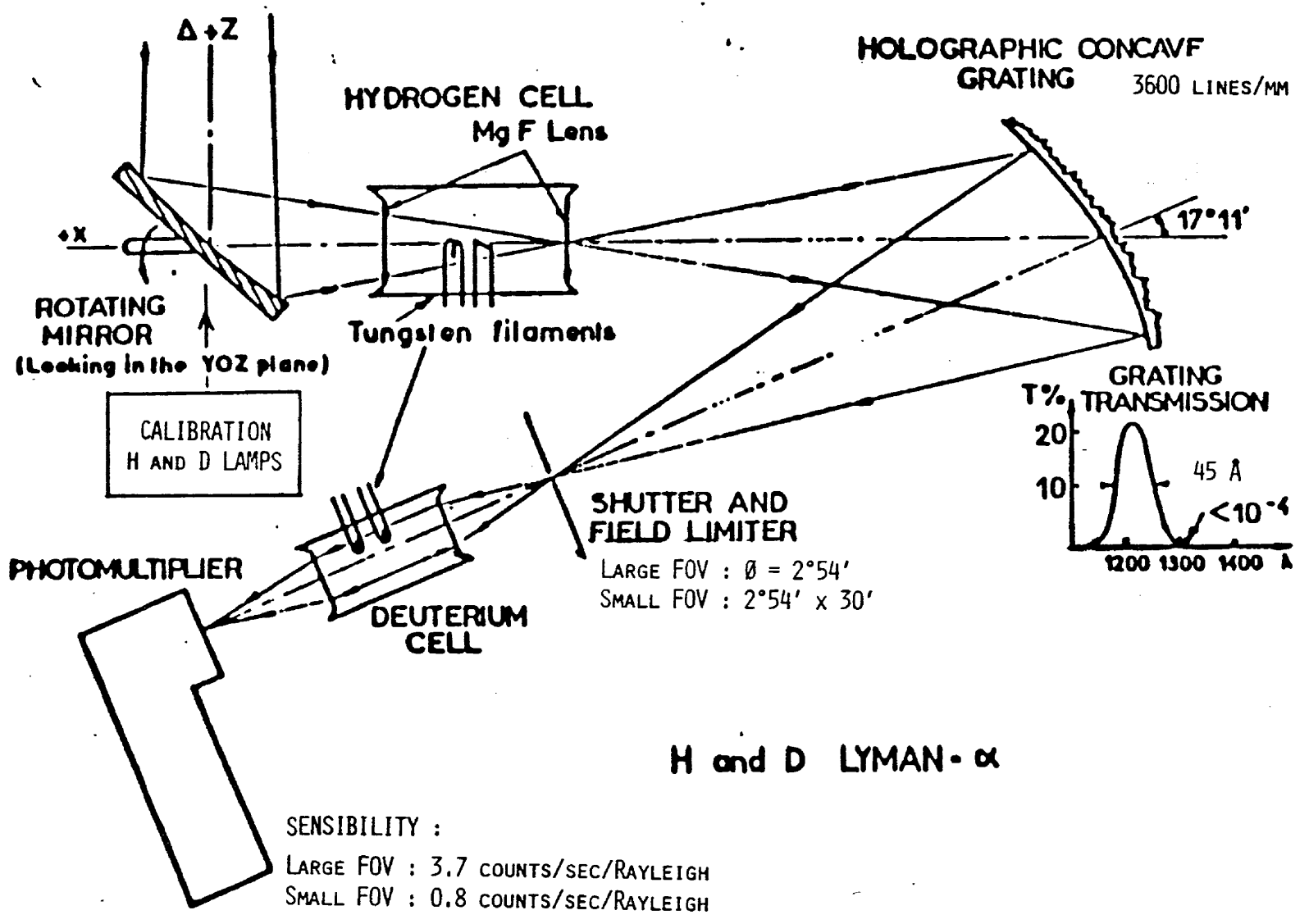
SCIENTIFIC OBJECTIVES

1. DEUTÉRIUM (DAY SIDE)
   - VERTICAL DISTRIBUTION
   - EDDY DIFFUSION COEFF. K AT 100 KM
   - TEMPERATURE (100 → 200 KM ?).

2. PROTON PRECIPITATIONS
   - AURORAL ZONES
   - EQUATORIAL ZONES
   - POLAR CUSP FOOT
   - PROTON GUN OBSERVATIONS.

3. ATMOSPHERIC HYDROGEN
   - NADIR : TOTAL H COLUMN
   - ZENITH : EXOBASE TEMPERATURE.


GALACTIC
EMISSION?
≃ 50 RAYLEIGH
W ≃ 5 A 10 Å
DEUTERIUM
LAYER
POLAR CUSP
200 RAYLEIGH
W = 2 10-2 Å
Ly -α D
AURORAE
EQUATORIAL
PRECIPITATION?
SUN
20 000 RAYLEIGH
W = 6 10-2 Å
H GEOCORONA
POLAR CUSP
200-500 RAYLEIGH
W = 6 10-2 Å
INTERPLANETARY EMISSION


Δ+Z
HYDROGEN CELL
Mg F Lens
HOLOGRAPHIC CONCAVE
GRATING
3600 LINES/MM
+X
17°11'
ROTATING
MIRROR
(Looking in the YOZ plane)
Tungsten filaments
CALIBRATION
H AND D LAMPS
GRATING
TRANSMISSION
T%
20
10
45 Å
<10⁻⁴
1200 1300 1400 Å
SHUTTER AND
FIELD LIMITER
LARGE FOV : Ø = 2°54'
SMALL FOV : 2°54' x 30'
PHOTOMULTIPLIER
DEUTERIUM
CELL
H and D LYMAN-α
SENSIBILITY :
LARGE FOV : 3.7 COUNTS/SEC/RAYLEIGH
SMALL FOV : 0.8 COUNTS/SEC/RAYLEIGH

INVESTIGATION ON ATMOSPHERIC H AND D THROUGH THE MEASUREMENT OF THEIR LYMAN-α EMISSIONS (1ES017)

J. L. Bertaux
Service d'Aéronomie du CNRS, France

The scientific objective of this experiment is to study various sources of Lyman-α emission in the atmosphere, in the interplanetary medium, and possibly in the galactic medium. The instrument is a spectrophotometer associated with two absorption cells, one filled with hydrogen, the other with deuterium (Fig. 1).

The main source of Lyman-α as seen from Spacelab is the result of resonance scattering of solar photons by atmospheric atomic hydrogen. This emission has been studied thoroughly with previous space experiments and is considered as "noise" in the present investigation; it is eliminated with the help of the hydrogen absorption cell run at a high absorption level. The other sources of Lyman-α are then studied (Fig. 2).

Lyman-α emission of atomic deuterium (D) is identified with the help of the deuterium absorption cell. Its intensity and line-width are measured, yeilding the verical distribution of D from 90 to approximately 250 kilometers and its temperature. From this vertical distribution, the eddy diffusion coefficient K around 100 kilometers is derived and mapped on the whole sunlit Earth.

Lyman-α emission resulting from charge exchange is possibly present at various places: auroral zones, equatorial zones, and possibly at the foot of the polar cusps, where the solar wind interacts directly with the neutral atmosphere. The foot of the polar cusps could be located precisely through observations of these regions with a scanning mirror.

Some emission is also expected from the plasma guns placed on board Spacelab.

Interplanetary hydrogen (which comes from the nearby interstellar medium) is a source of Lyman-α. It prevents astronomical observation of diffuse galactic Lyman-α emissions. With the help of the absorption cell, the level of diffuse galactic emission will be determined. The use of the absorption cell on Spacelab is also a test for determining if the presence of geocoronal and interplanetary emission will prevent future astronomical observations of Lyman-α emissions.

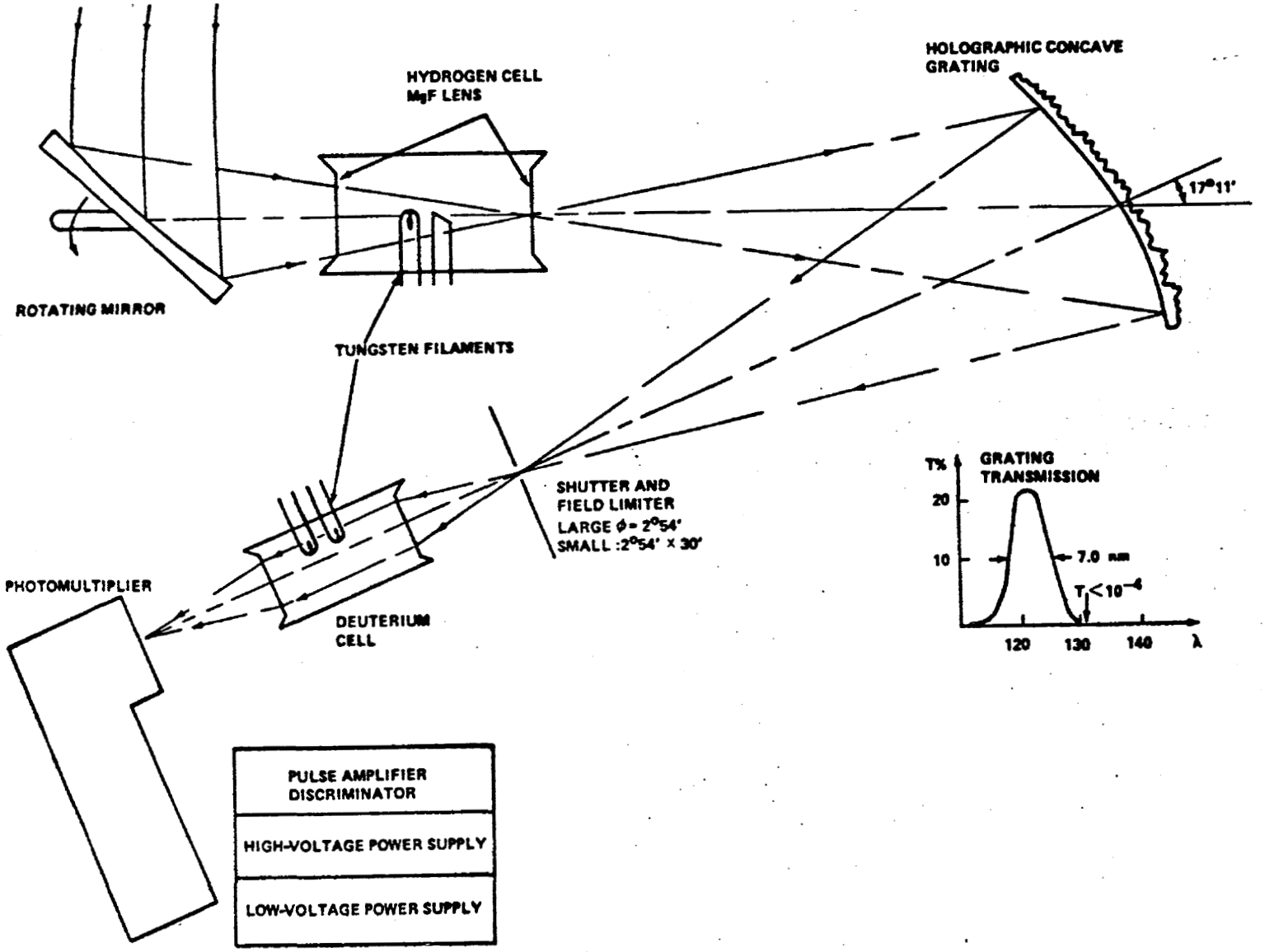


Figure 1. Schematic of instrument for measurement of hydrogen and deuterium Lyman-α emission.

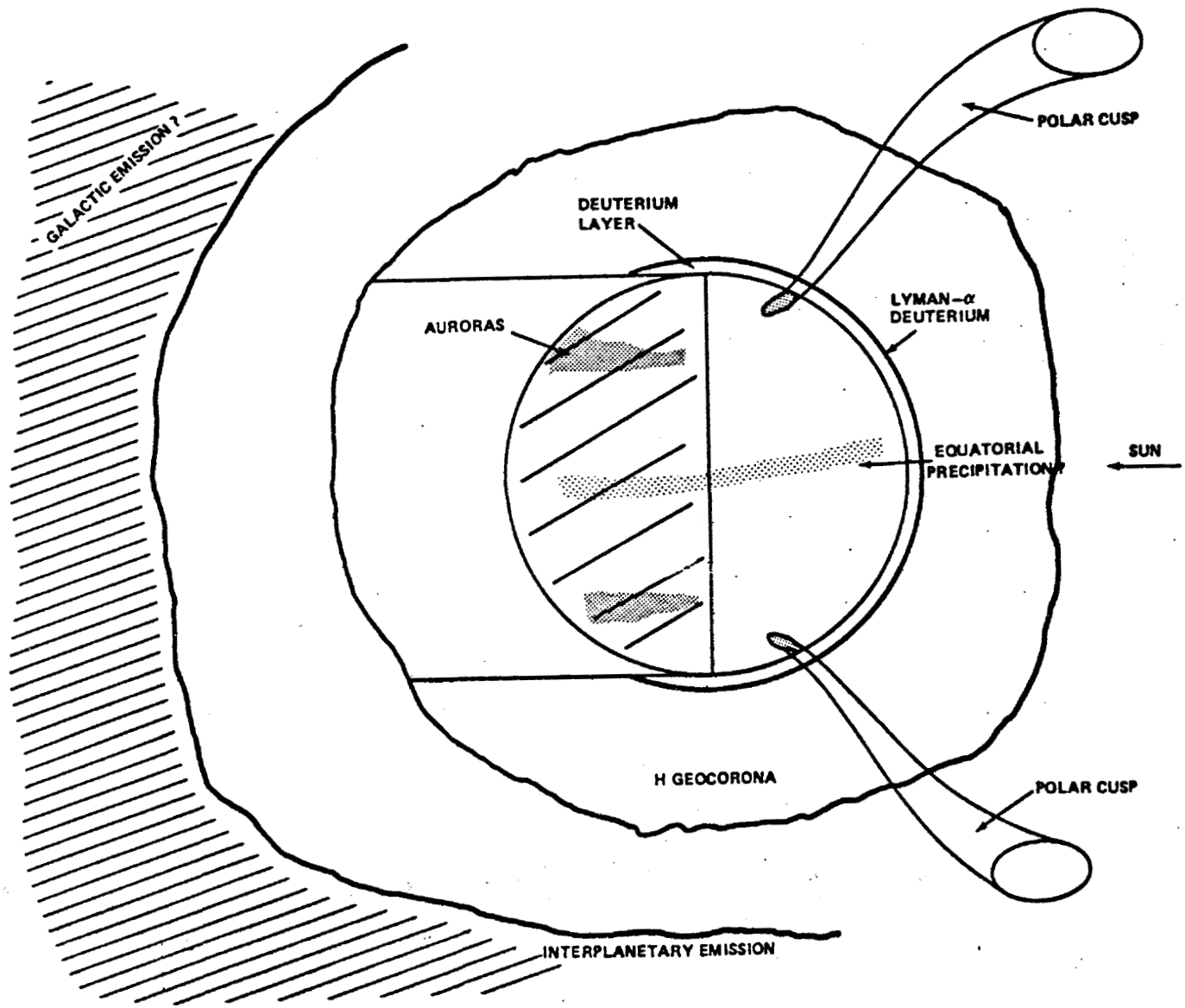


Figure 2. Sources of Lyman-α emissions.

SECTION II. ATMOSPHERIC EMISSION PHOTOMETRIC IMAGING (AEPI)